Moisture Dynamics in the Repository Footprint at Yucca Mountain

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RESEARCH OBJECTIVES

Measurements of rock water content and water potential are being pursued at the Exploratory Studies Facility (ESF) at Yucca Mountain, Nevada, to provide data for various numerical modeling efforts and for better understanding hydrologic processes. Recently, a Cross Drift was constructed as part of the Enhanced Characterization of the Repository Block (ECRB). This construction has provided the first opportunity for moisture measurements in the actual repository footprint. Because ventilation of the ESF and ECRB creates a dry-out zone around the drift that extends into the formation, the characterization of rock moisture properties needs to be coupled with investigations of moisture dynamics within the tunnel. The primary objective of this effort is to determine the status of water in the repository formation and the types of effects that are associated with ventilation of the ESF and ECRB.

APPROACH

Psychrometer measurements of water potential are being made along the length of boreholes installed at various locations within the ECRB and ESF. Additionally, electrical resistivity probes (ERPs) have been installed alongside the psychrometers to monitor temporal changes in moisture content. Along the tunnel bores humidity, temperature, barometric pressure and air velocity are being measured at various stations to provide information on moisture conditions along the tunnel.

The ventilation effects on the formation are being investigated on a section of the Cross Drift where construction of a bulkhead has sealed the ECRB from tunnel ventilation effects (at depths greater than 1,743 m). While the Main Drift and the rest of the ECRB are subject to ventilation affects associated with air movement along the tunnel, the area behind the bulkhead has largely remained sheltered. The bulkhead was installed in June 1999, and was exposed to tunnel ventilation for a couple of days in January 2000 and then again in April 2000.

ACCOMPLISHMENTS

Psychrometers and ERPs have been installed in three locations in the Cross Drift (two of which are located in the zone with minimized ventilation effects) and two locations in the Main Drift. Ten stations have been installed to monitor humidity, temperature and barometric pressure in the Cross Drift and Main Drift.

SIGNIFICANCE OF FINDINGS

Preliminary data suggest that ventilation effects within the ECRB have reduced water potentials between 1.4 and 2.0 m in distance from the tunnel. At greater distances, water potentials are >-10 m. When the bulkhead was opened briefly in January and April 2000, small puddles of moisture were observed about 1000-1200 m from the bulkhead.

The psychrometer data provides the first measurements of water potential in the potential repository formation. It shows that ventilation effects are important because they could potentially affect the advancement of water plumes into the main drift, thereby influencing the amount of seepage. However, beyond the zone affected by ventilation effects, the formation could be close to saturation. Observed puddles of water in the non-ventilated zones in the ECRB raise questions about the source of this water and the conditions leading to such condensation/seepage.

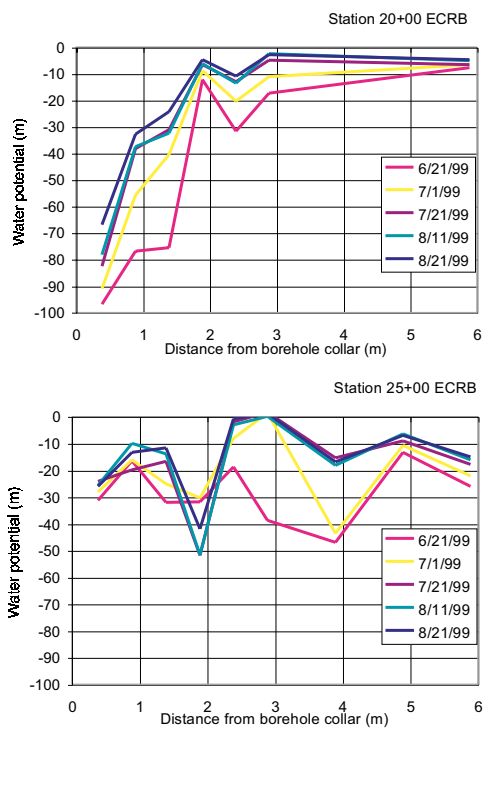

Figure 1. Water potential measurements from two locations within the ECRB after bulkhead installation in June, 1999. Station 20+00 was mined earlier and therefore shows more dry out (i.e., depth and magnitude of drying front) than Station 25+00.

ACKNOWLEDGEMENTS

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